Space Weather Technical Forecast

Issued on Monday 11 November 2024 at 13:13 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Moderate solar activity is likely, with a slight chance of X-class flares. Chance of G1/Minor Geomagnetic Storm intervals 13-14 Nov.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate during the period with four M-class flares, all from AR3889 in the southeast, the largest being an M9.4 flare at 10/1206 UTC. There are eight sunspot regions on the visible disc, with one as yet unnumbered region. AR3889, in the southeast, is the largest and most complex region. It contains a number of mature spots with at least two delta regions, although the one in the trailing region appears to be weakening. This spot has seen continued growth in penumbra especially around its leading portion, which seems to be the most active part. AR3883, in the southwest, has mature leading and trailing spots, and has seen some slight recent decay of its smaller spots occupying the intermediate region. The remaining spot regions are stable and magnetically simple.

No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Solar winds at L1 measured by ACE and DSCOVR were indicative of ongoing enhancement following likely CH HSS influences. Wind speeds were generally slightly elevated throughout, between 390-450 km/s. Density was average to below average. The Interplanetary Magnetic Field (IMF), Bt, was Moderate at first, around 9nT, then slowly declining to become Weak, around 5-8nT. The north-south component, Bz, was mostly southward (negative) directed at Weak levels with a maximum southward deflection of -8nT. Phi angle was predominantly positive (away from the Sun) throughout. A noticeable kick in the UK Magnetometers was observed around 10/1830 UTC, with Hartland showing a deflection of 118nT. This is possibly due to a localised substorm, perhaps in association with a weak transient feature or ongoing HSS, with no evidence of increased geomagnetic activity at L1 prior to this event.

Resultant Geomagnetic Activity was generally quiet to Active (Kp2-4), with a G2/Moderate Geomagnetic Storm (Kp6) interval at 10/1800-2100.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels throughout. The associated 24-hour fluence was well below the Active threshold, with 1.54e6 integrated flux observed at 11/0000UTC.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is forecast to continue, with a likelihood of isolated M-class flares and a slight chance of X-class flares, these probably from AR3889.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently forecast. HSS influences are expected through this period, initially from CH88/+ in the southwest and later from the large CH90/+ currently moving into the western hemisphere. Current slightly elevated winds are expected to decline to background through Days 1-2 (11-12 Nov), before becoming elevated again with any connection to CH90/+ through Days 3-4 (13-14 Nov).

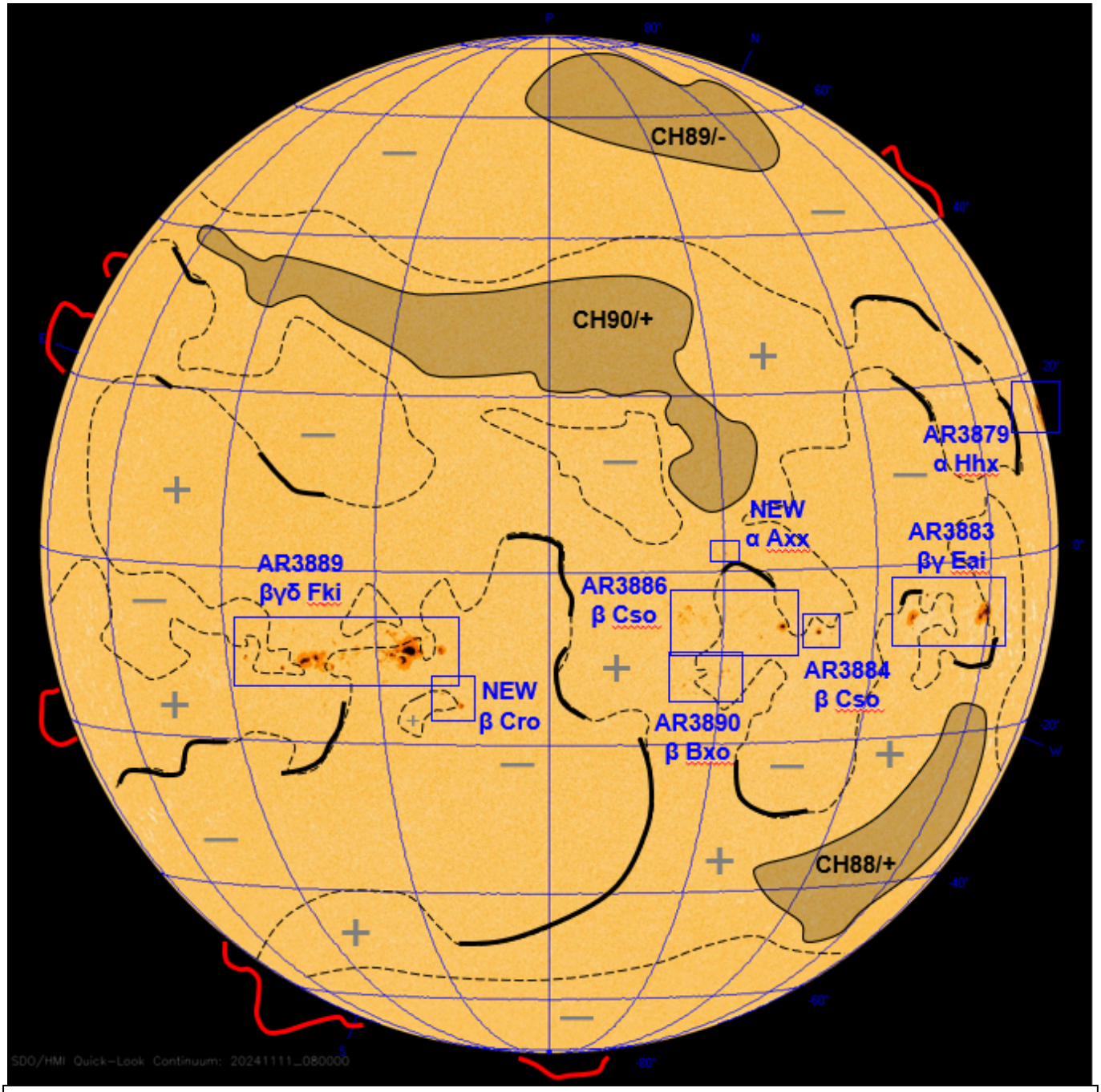
Generally Quiet to Unsettled (Kp1-3) activity is forecast for Days 1-2 (11-12 Nov) as coronal hole influence eases, with a chance of Active (Kp4) intervals at first but this risk declining into Day 2. More Unsettled to Active (Kp3-4) conditions then expected through Days 3-4 (13-14 Nov) due to a HSS from CH90/+, with a slight chance of G1/Minor Geomagnetic Storm intervals (Kp5).

Energetic Particles / Solar Radiation: High energy proton flux at GOES-18 is at normal background levels. There is a rising slight chance of S1/Minor Proton Storms later in the period, mainly due to any significant flares from AR3889 as it rotates into a more geoeffective position in the western hemisphere. The high energy electron flux is expected to remain at generally Background to Moderate levels. The associated fluence is excepted to persist below Active levels.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 1: Solar Synoptic Map valid 11/0800UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms

No Earth-directed CMEs are currently forecast. A CME was observed off the western limb in association with a C8.4 flare at 10/2253UTC, but is expected to pass comfortably ahead of Earth. A filament eruption was also observed in the northeastern quadrant around 11/0100UTC, with a faint narrow CME observed in coronagraph imagery. Initial analysis suggests this is passing behind Earths orbit.

Solar winds are currently enhanced following either weak transient arrivals, or more likely coronal hole HSS influences from CH88/+ in the southwest. Slightly Elevated solar wind speeds are considered most likely at first, just above 400 km/s, before slowly easing through the rest of Day 1 (11 Nov) into Day 2 (12 Nov). Solar wind speeds expected to stay at background levels through Day 2 (12 Nov) in the absence of further enhancement. An increase in solar winds to 450-500 km/s then likely Day 3 or into Day 4 (13-14 Nov) with an expected connection to some portion of the large coronal hole CH90/+ currently moving into the western hemisphere. MOSWOC Enlil is providing reasonable guidance for the start of the period, however it doesn't have any connection to CH90/+ signalled, and as such confidence in Enlil lowers through the period.

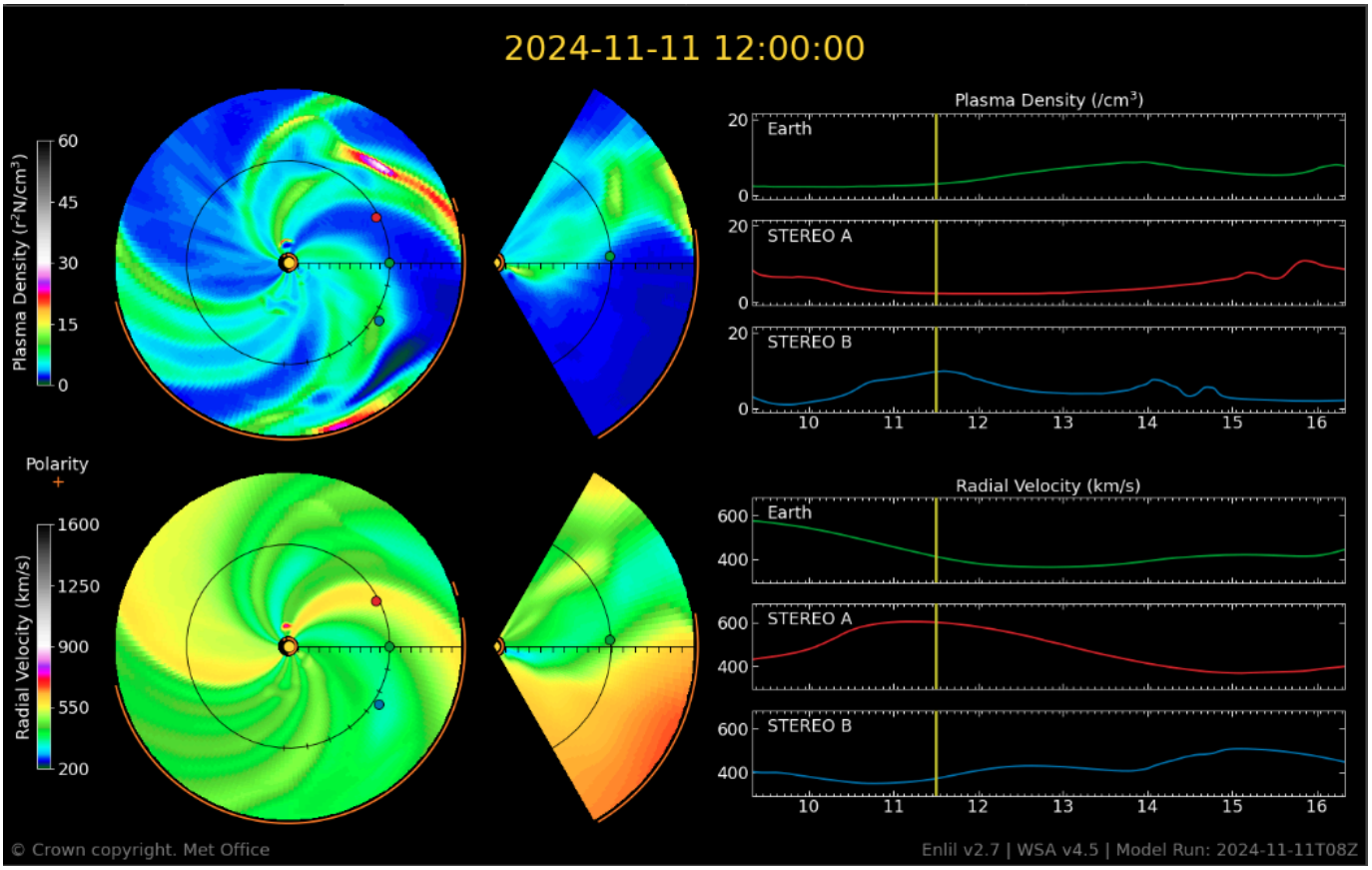
Generally Quiet to Unsettled (Kp1-3) activity is forecast for Days 1-2 (11-12 Nov) as coronal hole influence eases, with a chance of Active (Kp4) intervals at first but this risk declining into Day 2. More Unsettled to Active (Kp3-4) conditions then expected through Days 3-4 (13-14 Nov) due to a HSS from CH90/+, with a slight chance of G1/Minor Geomagnetic Storm intervals (Kp5).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	Yes	20	10	30	30
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 2: MOSWOC Enlil model. Note the absence of any connection to CH90/+ later in the period.



© Crown Copyright 2024. All Rights Reserved.

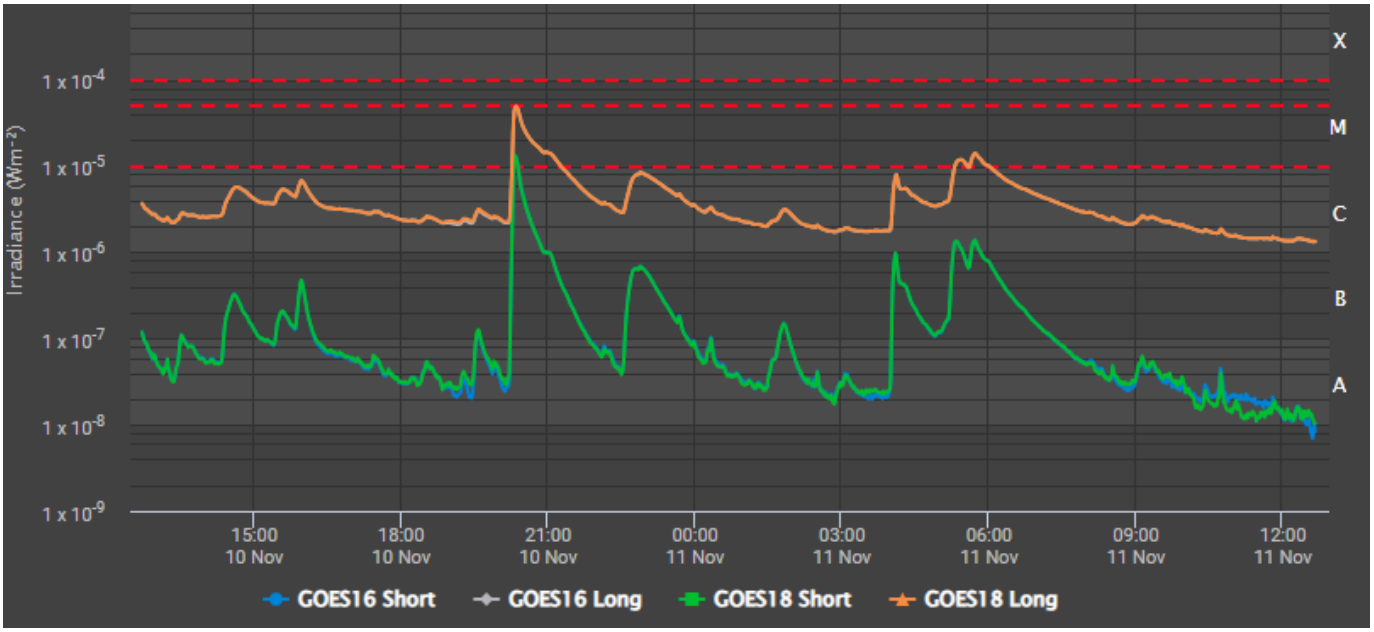
Radio Blackouts - X-Ray Flares

Solar activity was Moderate during the period with four M-class flares, all from AR3889 in the southeast, the largest being an M9.4 flare at 10/1206 UTC. There are eight sunspot regions on the visible disc, with one as yet unnumbered region. AR3889, in the southeast, is the largest and most complex region. It contains a number of mature spots with at least two delta regions, although the one in the trailing region appears to be weakening. This spot has seen continued growth in penumbra especially around its leading portion, which seems to be the most active part. AR3883, in the southwest, has mature leading and trailing spots, and has seen some slight recent decay of its smaller spots occupying the intermediate region. AR3879 in the northwest is large and mature, though appears stable and will soon rotate over the western limb. The remaining spot regions are smaller and magnetically simple.

Moderate activity is forecast to continue, with a likelihood of isolated M-class flares and a slight chance of X-class flares, these probably from AR3889.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	70	70	70	70
Very Active	R3-R5 (X Class)	No	20	20	20	20

Figure 3: GOES-16 & -18 X-ray flux



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES-18 is at normal background levels. There is a rising slight chance of S1/Minor Proton Storms later in the period, mainly due to any significant flares from AR3889 as it rotates into a more geoeffective position in the western hemisphere.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

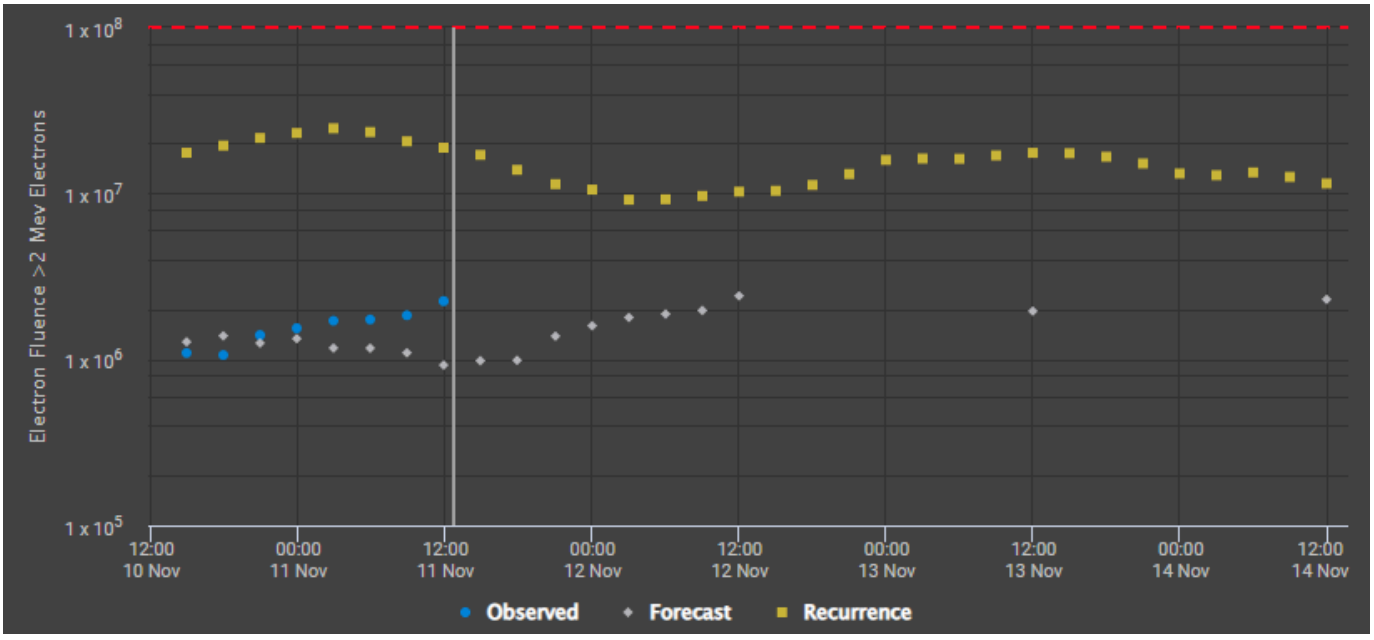
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is at Background levels.

The high energy electron flux is expected to remain at generally Background to Moderate levels, potentially increasing to brief High levels at diurnal peak early in the period. The associated 24 hour fluence is expected to remain below Active levels aligning with the MOSWOC REFM output, which appears to provide reliable guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: MOSWOC REFM, deemed to be providing good guidance currently.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.